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(54) Title: **A weather resistant resin composition with improved colouring property, chemical resistance and rib strength**

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## **Text of specifications**

### **1. Title**

A weather resistant resin composition with improved colouring property, chemical resistance and rib strength.

### **2. Claims**

1) A weather resistant resin composition with improved colouring property, chemical resistance and rib strength comprising of 5-90 wt.% of a graft polymer (I), 5-90 wt.% of another graft polymer (II), 5-90 wt.% of an unsaturated carboxylic acid alkyl ester-based polymer (III) and 0-85 wt.% of a polymer or copolymer (IV), where (I), (II) and (IV) are:

(I) A graft polymer obtained by graft polymerisation of one or more types of monomers selected from aromatic vinyl monomers, vinyl cyanide monomers and unsaturated carboxylic acid alkyl ester monomers, on to an ethylene- $\alpha$ -olefin rubber, 40 wt.% or less of the true graft polymer portion of (I) being soluble in a 1:4 (v/v) mixture of tetrahydrofuran and n-hexane, and 60 wt.% or less of the true graft polymer portion being insoluble in tetrahydrofuran;

(II) A graft polymer obtained by graft polymerisation of one or more types of monomers selected from aromatic vinyl monomers, vinyl cyanide monomers and unsaturated carboxylic acid alkyl ester monomers, on to an alkyl acrylate rubber with 1-16 carbons; and

(IV) A polymer (or copolymer) of one or more types of monomers selected from aromatic vinyl monomers and vinyl cyanide monomers.

- 2) The weather resistant resin composition specified in 1) above in which (I) is a graft polymer with 10-60 wt.% of ethylene- $\alpha$ -olefin rubber, and 90-40 wt.% of the monomer(s) and 20-40 wt.% or of the true graft polymer portion of (I) is soluble in the solvent mixture of tetrahydrofuran and n-hexane, and  $\leq$ 50 wt.% of it is insoluble in tetrahydrofuran.
- 3) The weather resistant resin composition specified in 1) above where (II) is a graft polymer of 10-60 wt.% of an alkyl acrylate rubber with 2-12 carbons and a mean particle size (weight average) of 0.05-0.4  $\mu\text{m}$  and 90-40 wt.% of monomer(s).
- 4) The weather resistant resin composition specified in 1) above where the weight ratio of graft polymer (I) / graft polymer (II) is (50 to 90) / (50 to 10).
- 5) The weather resistant resin composition specified in 1) above where the unsaturated carboxylic acid alkyl ester-based polymer (III) consists of 40 wt.% or more of methyl methacrylate and 60 wt.% or less of one or more monomers selected from styrene,  $\alpha$ -methyl styrene and acrylonitrile.

### **3. Detailed description of the invention**

<Field of Industrial Application>

The present invention deals with a weather resistant resin composition based on ethylene- $\alpha$ -olefin rubber and alkyl acrylate rubber and has improved colouring property, chemical resistance and rib strength. This resin composition does not have laminar detachment and has superior impact resistance and workability.

<Prior Art>

The technology of introducing rubber into resins has been used for improving their mechanical characteristics, impact resistance in particular, as can be seen in high impact polystyrene (HIPS) and ABS resins. In recent years, weather resistant resins like AES, ACS and AAS resins, in which a non-conjugated diene rubber is used as the

rubber component, are drawing attention because non-conjugated diene rubbers have better weather resistance than conjugated diene rubbers like polybutadiene.

These resins have better weather resistance compared to conjugated diene rubber-containing resins like ABS resin. But they are inferior in colouring property, chemical resistance, rib strength, impact resistance and workability, apart from their major drawback of proneness to laminar detachment of moulded products.

<Solution>

As a result of painstaking investigations aimed at overcoming the shortcomings of the above-mentioned weather resistant resins, the present investigators found out that weather resistant resin compositions comprising two specific types of graft polymers and an unsaturated carboxylic acid alkyl ester-based polymer have improved colouring property, chemical resistance and rib strength. This led to the present invention.

In short, the new invention provides a weather resistant resin composition with improved colouring property, chemical resistance and rib strength comprising of 5-90 wt.% of a graft polymer (I), 5-90 wt.% of another graft polymer (II), 5-90 wt.% of an unsaturated carboxylic acid alkyl ester-based polymer (III) and 0-85 wt.% of a polymer or copolymer (IV), where (I), (II) and (IV) are:

- (I) A graft polymer obtained by graft polymerisation of one or more types of monomers selected from aromatic vinyl monomers, vinyl cyanide monomers and unsaturated carboxylic acid alkyl ester monomers, on to an ethylene- $\alpha$ -olefin rubber, 40 wt.% or less of the true graft polymer portion of (I) being soluble in a 1:4 (v/v) mixture of tetrahydrofuran and n-hexane, and 60 wt.% or less of the true graft polymer portion being insoluble in tetrahydrofuran;
- (II) A graft polymer obtained by graft polymerisation of one or more types of monomers selected from aromatic vinyl monomers, vinyl cyanide monomers and unsaturated carboxylic acid alkyl ester monomers, on to an alkyl acrylate rubber with 1-16 carbons; and

(IV) A polymer (or copolymer) of one or more types of monomers selected from aromatic vinyl monomers and vinyl cyanide monomers.

The new invention is explained below in greater detail.

o Ethylene- $\alpha$ -olefin rubber

The ethylene- $\alpha$ -olefin rubber, an essential component of the graft polymer (I) in the new invention is a two-component copolymer of ethylene plus propylene or butene (EPR); a three-component copolymer of ethylene, propylene or butene and a non-conjugated diene (EPDM); etc. One or more such copolymers can be used as the ethylene- $\alpha$ -olefin rubber.

The non-conjugated diene in the EPDM can be, for instance, dicyclopentadiene, ethylenedene norbornene, 1,4-hexadiene, 1,4-cycloheptadiene, 1,5-cyclooctadiene.

The preferable range of molar ratio of ethylene and propylene (or butene) in EPR and EPDM is 5:1 to 1:3.

In EPDM, the proportion of the non-conjugated diene must preferably be in the range of 2 to 50 in terms of the iodine value.

o Alkyl acrylate rubber

The alkyl acrylate rubber, which is a component of graft polymer (II), is an elastic material obtained by polymerisation (or copolymerisation), in the presence or absence of a cross-linking agent, of one or more types of alkyl acrylates having 1-16 carbons in the alkyl group and one or more copolymerisable monomers if needed. One or more such elastic materials is used as the alkyl acrylate rubber.

The alkyl acrylate with 1-16 carbons in the above-mentioned elastic material can be methyl acrylate, ethyl acrylate, butyl acrylate, 2-ethylhexyl acrylate, etc. It is preferable to have 2-12 carbons in the alkyl acrylate for achieving sufficient rubber like elasticity.

Other monomers that are copolymerisable with the alkyl acrylate are aromatic vinyl compounds like styrene,  $\alpha$ -methyl styrene and vinyl toluene; vinyl cyanide compounds like acrylonitrile and methacrylonitrile; methacrylic acid esters such as methyl methacrylate; conjugated diene compounds like butadiene; 2-chloroethylvinyl

ether; vinyl monochloroacetate; methoxyethyl acrylate; etc. The total amount of these copolymerisable monomers in the elastic material is not more than 90 wt.%. 60 wt.% or less is preferable, considering the colouring property and impact resistance of the final resin composition.

Examples of cross-linking agents that can be used are divinyl benzene, ethyleneglycol dimethacrylate, diaryl malaeate, triaryl cyanurate, triaryl isocyanurate, diaryl phthalate, trimethylol propane triacrylate and aryl methacrylate. The amount of cross-linking agent should preferably not exceed 15 parts by weight per 100 parts by weight of the alkyl acrylate and the copolymerisable monomer combined.

The alkyl acrylate rubber may be prepared by a standard method of polymerisation, like emulsion polymerisation, bulk polymerisation, suspension polymerisation, solution polymerisation and a combination of such methods. However, emulsion polymerisation is preferable because of the ease in controlling the shape and size of the rubber particles formed. For instance, the rubber particle size can be adjusted by adding an acidic substance in the latex and allowing the latex particles to aggregate. Sulphuric acid, phosphoric acid, acetic acid, anhydrous acetic acid, etc can be used for this.

The alkyl acrylate rubber used in this invention can have any mean particle size (weight average), but the preferable range is 0.02 to  $0.5\mu\text{m}$ . With a particle size of less than  $0.02\mu\text{m}$ , the impact resistance of the final resin composition will not be sufficient whereas more than  $0.5\mu\text{m}$  will adversely affect the appearance of the resin composition by affecting the colouring property. A particle size range of 0.1- $0.4\mu\text{m}$  is particularly suitable. Furthermore, rubber particles of two or more mean particle sizes can be mixed to achieve the above mentioned suitable mean particle size range. This mixing can be done at the rubber latex stage, before or after graft polymerisation, at the graft powder stage after salting out of the graft latex, or after melting and pelletising the graft powder.

#### o Monomers for graft polymerisation

Monomers that can constitute the graft polymers (I) and (II) are listed below.

Aromatic vinyl monomers like styrene,  $\alpha$ -methyl styrene, P-methyl styrene, vinyl toluene, methyl- $\alpha$ -methyl styrene, t-butylstyrene and chlorostyrene. One or more of these monomers can be used. Styrene is most suitable.

Vinyl cyanide monomers like acrylonitrile, methacrylonitrile, etc. One or more of these can be used. Acrylonitrile is particularly suitable.

Unsaturated carboxylic acid alkyl ester monomers like methyl acrylate, ethyl acrylate, butyl acrylate, methyl methacrylate, ethyl methacrylate, butyl methacrylate, hydroxyethyl acrylate, hydroxyethyl methacrylate, hydroxypropyl methacrylate, and glycidyl acrylate, glycidyl methacrylate that have epoxy group in their molecule. One or more of these can be used. Methyl methacrylate is most suitable.

One or more types of monomers selected from the list given above is graft polymerised with ethylene-olefin rubber or an alkyl acrylate rubber to obtain graft polymer (I) or graft polymer (II).

Thus, the preferable monomers for graft polymers (I) and (II) are one or more selected from styrene, acrylonitrile and methyl methacrylate. The combination of styrene and acrylonitrile is particularly preferable.

The proportion of ethylene- $\alpha$ -olefin rubber or alkyl acrylate rubber and the monomer(s) in (I) and (II) is not specified in this invention. But for better physical properties in the final resin composition, it is preferable to use 5-95 wt.% of ethylene- $\alpha$ -olefin rubber (or alkyl acrylate rubber) and 95-5 wt.% of the monomer(s). A more preferable range is 10-60 wt.% of the rubber and 90-40 wt.% of the monomer(s).

40 wt.% or less of the true graft polymer portion of (I) should be soluble in a 1:4 (v/v) mixture of tetrahydrofuran and n-hexane, and 60 wt.% or less should be insoluble in tetrahydrofuran.

If more than 40 wt.% is soluble in the solvent mixture, the chemical resistance, rib strength and impact resistance of the composition would be adversely affected and the material would become prone to laminar detachment, although the workability of the material would improve. Considering the balance between the impact resistance and workability, it is preferable for this fraction to be 10-40 wt.%, more preferably 20-40 wt.%.

With more than 60 wt.% of terahydrofuran-insoluble fraction, the colouring property of the final resin composition will not be satisfactory. Therefore it should preferably be not be more than 50 wt.%.

In graft polymerisation, it is difficult to graft on to the rubber, all of the monomers fed into the reaction system. This sometimes leads to the production of polymers or copolymers consisting only of the monomer(s) used (without the rubber). In this invention, we shall not make any distinction and shall consider these by-product polymers and copolymers also as part of the "graft polymer (I)". However, this distinction is made for specifying the soluble and insoluble fractions of the "true graft polymer portion of (I)". For this purpose, the by-product polymer or copolymer produced during the graft polymerisation is not included in the "true graft polymer". For determining the soluble and insoluble fractions, the true graft polymer alone is separated from the "graft polymer (I)" using methylethyl ketone.

The soluble and insoluble fractions of the true graft polymer of the graft polymer (I) are measured under the conditions given below.

The graft polymer (I) is immersed in about 100 times its amount of methylethyl ketone for 24 h (at room temperature). The whole mixture is then centrifuged for 20 minutes at 12,000 rpm to separate into methylethyl ketone-soluble and insoluble fractions. The insoluble fraction alone (the true graft polymer) is then recovered.

The true graft polymer is then hot-pressed for 5 minutes at 200° C to prepare sheets of thickness about 1mm. 1g of this sheet is immersed in 200ml of 1:4 (v/v) tetrahydrofuran:n-hexane mixture at room temperature for 48 h. After that, it is filtered through a 300 mesh filter and the soluble fraction is determined.

Similarly, 1g of the true graft polymer sheet is soaked in 200ml of tetrahydrofuran at room temperature for 48 h and filtered through a 300 mesh filter to determine the tetrahydrofuran-insoluble fraction.

Graft polymer (I) with 40 wt.% or less of its true graft polymer portion soluble in the tetrahydrofuran – n-hexane solvent mixture and 60 wt.% insoluble in tetrahydrofuran can be obtained by suitably choosing the type (iodine value and Mooney viscosity) of ethylene- $\alpha$ -olefin rubber, type and amount of the initiator and molecular weight regulator, and the polymerisation temperature. Emulsion polymerisation, bulk polymerisation, suspension polymerisation, solution polymerisation, or a combination of these methods of polymerisation may be used for

preparing the graft polymer (I). Suspension polymerisation and solution polymerisation are preferable because it is easy to regulate the above-mentioned polymerisation conditions when using these methods.

For polymerising graft polymer (II), a constituent of the newly invented weather resistant resin composition, emulsion polymerisation, bulk polymerisation, suspension polymerisation, solution polymerisation, or a combination of these methods of polymerisation may be used. Among these, emulsion polymerisation, suspension polymersation and emulsion-suspension polymerisation are preferable because with these methods it is easy to control the size and shape of the rubber particles.

Graft polymerisation to prepare graft polymers (I) and (II) may be carried out in one step or using a multi-stage method, by changing the composition of the monomers.

- o      Unsaturated carboxylic acid alkyl ester-based polymer

The unsaturated carboxylic acid alkyl ester-based polymer (III) of the newly invented resin composition is a polymer or copolymer having an unsaturated carboxylic acid alkyl ester monomer as the essential component. In addition, it can also contain, one or more compounds selected from aromatic vinyl monomers and vinyl cyanide monomers copolymerised with it.

Practical examples of the unsaturated carboxylic acid alkyl ester monomers, aromatic vinyl monomers and vinyl cyanide monomers are the same as the compounds listed earlier as applicable examples of monomers for graft polymerisation.

As the monomers of polymer (III), it is preferable to use methyl methacrylate alone or methylmethacrylate combined with one or more compounds selected from styrene,  $\alpha$ -methyl styrene and acrylonitrile.

The suitable proportion of these compounds, considering the colouring property of the resin composition, is 20-100 wt.% of methyl methacrylate, 0-80 wt.% of one or more compounds selected from styrene,  $\alpha$ -methyl styrene and acrylonitrile. 40-100 wt.% of methyl methacrylate is particularly suitable.

The intrinsic viscosity of the unsaturated carboxylic acid alkyl ester-based polymer (III) is not specified here. But the preferable range is 0.1 to 1.5 in chloroform

at 30° C, considering the physical properties of the final resin composition. Emulsion polymerisation, bulk polymerisation, suspension polymerisation, solution polymerisation, or a combination of these methods of polymerisation may be used for preparing the graft polymer (III).

o      Polymer or copolymer (IV)

If necessary, a polymer or copolymer consisting of one or more monomers selected from aromatic vinyl monomers and vinyl cyanide monomers may also be compounded, if necessary, to the newly invented weather resistant resin composition. Examples of aromatic vinyl monomers and vinyl cyanide monomers are the same as listed earlier as monomers for graft polymerisation. The preferable aromatic vinyl monomers are styrene and  $\alpha$ -methyl styrene and the preferable vinyl cyanide monomer is acrylonitrile.

The preferable polymer or copolymer (IV) are styrene-acrylonitrile copolymer,  $\alpha$ -methyl styrene acrylonitrile copolymer and styrene- $\alpha$ -methyl styrene-acrylonitrile copolymer.

The polymer or copolymer (IV) can have any intrinsic viscosity but the preferable range is 0.4 to 1.1 in dimethyl formamide at 30° C, considering the physical properties of the final resin composition. Bulk polymerisation, suspension polymerisation, solution polymerisation, emulsion polymerisation or a combination of these methods of polymerisation may be used to prepare (IV).

o      Resin composition

In the newly invented weather resistant resin composition, the proportions of the different constituents are 5-90 wt.% of graft polymer (I), 5-90 wt.% of graft polymer (II), 5-90 wt.% of the unsaturated carboxylic acid alkyl ester-based polymer (III) and 0-85 wt.% of copolymer or polymer (IV).

With more than 90 wt.% of graft polymer (II), the impact resistance, low temperature impact resistance in particular, of the resin composition would be poor, whereas with less than 5 wt.% the resin would not have sufficiently improved chemical resistance and rib strength and the material would have the problem of proneness to laminar detachment and poor colouring property. A graft polymer (I) : graft polymer (II) ratio of 50-90 : 50-10 is particularly suitable.

With more than 90 wt.% of the unsaturated carboxylic acid alkyl ester-based polymer (III), the resin composition would have poor impact resistance and poor thermal stability. With less than 5 wt.% bright colouring would not be possible because of poor colouring property. A particularly preferable range for the proportion of (III) is 10-80 wt.%.

The suitable amount of polymer or copolymer (IV) to be used differs depending on the production method used for preparing the graft polymers (I) and (II) and in particular the graft polymerisation ratio of ethylene- $\alpha$ -olefin rubber or alkyl acrylate rubber with the other monomers. The preferable proportion of polymer or copolymer (IV) is 0-80 wt% for getting good impact resistance.

Graft polymers (I) and (II), the unsaturated carboxylic acid alkyl ester-based polymer (III) and the polymer or copolymer (IV) can be mixed in Banbury mixer, uni- or biaxial extruder, or a combination of these.

Apart from these components, the newly invented resin composition can contain, if necessary, various conventional additives like dyes, pigments, antioxidants, plasticizers, antistatic agents, UV absorbers, lubricants, fillers, flame retardants, etc. Furthermore, it can contain thermoplastic resins like ABS resin, MBS resin, ABSM resin, ACS resin, polyniyl chloride, ethylene-vinyl chloride copolymer, chlorinated polyethylene, styrene-maleic anhydride copolymer, styrene-acrylonitrile-maleic anhydride copolymer, styrene-maleimide-based copolymer, styrene-acrylonitrile-maleimide-based copolymer, thermoplastic polyester, polyamide, polyacetal, polycarbonate, polysulphone, etc.

The new invention will be explained below with the help of some practical examples. But the scope of the new invention will in no way be limited by these examples.

#### Examples

##### <Preparation of graft polymer (I)>

- Suspension polymerisation -

50 parts by weight of ethylene- $\alpha$ -olefin rubber, 35 parts by weight of styrene and 15 parts by weight of acrylonitrile were subjected to standard suspension polymerisation, for graft polymerisation.

Graft polymers (I) with different amounts of soluble and insoluble components in its true graft polymer portion were prepared in the above polymerisation step by using rubbers of different iodine value and Mooney viscosity, different amounts and types of polymerisation initiator, different amounts molecular weight regulators in some cases, and/or by changing the polymerisation temperature.

- Solution polymerisation -

20 parts by weight of ethylene- $\alpha$ -olefin rubber, 55 parts by weight of styrene and 25 parts by weight of acrylonitrile were subjected to standard solution polymerisation to prepare graft polymers (I).

Graft polymers (I) with different amounts of soluble and insoluble components in the true graft polymer portion were prepared in this polymerisation also, by varying the type of polymerisation initiator used.

Table 1 gives the conditions of graft polymerisation and its results.

Table 1

*Translator's key to Table 1*

Column titles

Polymer No.

Ethylene- $\alpha$ -olefin rubber

(Iodine value) (Mooney viscosity)

Initiator

(Parts by weight)

Molecular weight regulator

(Parts by weight)

Polymerisation temperature (° C)

Method of Polymerisation

True graft polymer portion of graft polymer (I)

Grafting percentage (%)      Soluble component (%)      Insoluble component (%)

Entries under column

Method of polymerisation

(I)-1 Suspension

(I)-5 Solution

(I)-6 Suspension

(I)-8 Solution

(I)-9 Suspension

Footnotes

EPDM: Ethylene-propylene-ethylidene norbornene copolymer(propylene content 50%)

PV : *t*-butyl peroxide pivalate

BPO : Benzoyl peroxide

LPO : Lauroyl peroxide

O : *t*-butylperoxy-2-ethylhexanoid

TDM : *t*-dodecylmercaptan

<Preparation of graft polymer (II)>

95 parts by weight of butylacrylate, 5 parts by weight of acrylonitrile and one part by weight of ethylene glycol dimethacrylate were polymerised by a standard emulsion polymerisation method to prepare alkyl acrylate rubber latex having mean rubber particle size (weight average) of  $0.23\mu\text{m}$ .

After this, 50 parts by weight of a monomer mixture (solution) consisting of 70 wt.% styrene, 20 wt.% acrylonitrile and 10 wt.% methyl methacrylate was added per 50 parts by weight of solid component in the latex and the mixture polymerised by a standard emulsion polymerisation method to obtain graft polymer (II).

<Preparation of unsaturated carboxylic acid alkyl ester-based polymer (III)>

*t*-Dodecyl mercaptan (see Table 2 below for amounts) and 0.5 parts by weight of benzoyl peroxide were added to 100 parts by weight of a monomer mixture having the composition shown in Table 2 and subjected to polymerisation in an aqueous dispersion for 8h at  $80^\circ\text{C}$ . By dehydrating the polymerisation product, unsaturated

carboxylic acid alkyl ester-based polymers with intrinsic viscosity shown in Table 2 were obtained.

*Key to Table 2*

Column title

Unsaturated carboxylic acid alkyl ester-based polymers (III)

Row titles

Proportion in monomer mixture (wt.%)      Styrene

Acrylonitrile

Methyl methacrylate

*t*-dodecylmercaptan (parts by wt.)

Intrinsic viscosity (in chloroform at 30° C)

<Preparation of copolymer (IV)>

0.2 parts by weight of *t*-dodecylmercaptan and 0.5 parts by weight of benzoyl peroxide were added to 100 parts by weight of a monomer mixture (solution) consisting of 70 parts by weight styrene and 30 parts by weight acrylonitrile. The mixture was subjected to polymerisation in an aqueous dispersion system for 8 h at 80° C. After dehydration, copolymer (IV) with intrinsic viscosity 0.67 (in dimethyl formamide at 30° C) was obtained.

A total of 100 parts by weight of the above-prepared graft polymer (I), graft polymer (II), unsaturated carboxylic acid alkyl ester-based polymer (III) and the copolymer (IV) were mixed with 1.0 parts by weight of carbon #1000B and blended in a Banbery mixer for 4 minutes at 200° C to obtain the compositions shown in Tables 3 to 5. These compositions were injection moulded and the colouring property, chemical resistance, rib strength, laminar detachment, impact strength and workability of the mouldings were evaluated. The results of evaluations are given in Tables 3-5.

*Key to Table 3*

Column titles

Mixing proportion (wt.%)

Graft polymer (I)

Polymer No. (Table 1)

Amount

Graft polymer (II)

Unsaturated carboxylic acid alkyl ester-based polymer (III)

Polymer No. (Table 2)

Amount

Copolymer (IV)

Colouring property (blackness, visually assessed)

Chemical resistance (whitening)

Rib strength (kg, at 23° C)

Laminar detachment

Impact strength (kg cm/cm, notched Izod)

Workability (cc/min), "Koka" method processing at 210° C, 30kg/cm<sup>2</sup>.

Entries under columns

Examples 1-15

Colouring property

Example-1 Good

Example-12 Fairly good

Example-13 Good

Chemical resistance

Example-1 No

Example-12 Slight

Example-13 No

Laminar detachment

Example-1 No

*Key to Table 4*

Column titles same as for Table 3

Entries under columns

Examples 16-33

Colouring property

Example-16 Good

Example-27 Fairly good

Example-28 Good

Example-31 Fairly good

Example-32 Good

Chemical resistance

Example-16 No

Example-27 Slight

Example-28 No

Laminar detachment

Example-16 No

*Key to Table 5*

Column titles same as for Table 3

Entries under columns

Comparative examples 1-15

Colouring property

Comp. Example-1 Poor

Comp. Example-4 Good

Comp. Example-6 Poor

Comp. Example-9 Good

Comp. Example-11 Poor

Comp. Example-14 Good

Chemical resistance

Comp. Example-1 No

Comp. Example-4 Yes

Comp. Example-6 No

Comp. Example-9	Yes
Comp. Example-11	No
Comp. Example-12	Yes
Comp. Example-14	No
<b>Laminar detachment</b>	
Comp. Example-1	No
Comp. Example-4	Slight
Comp. Example-6	No
Comp. Example-9	Slight
Comp. Example-11	No
Comp. Example-12	Yes
Comp. Example-14	No

- Moulding conditions -

Injection moulding machine manufactured by Toshiba Machine Co. Ltd., IS-90B (5 ounce).

Moulding temperature:	240° C
Mould temperature:	60° C
Injection pressure:	100kg/cm <sup>2</sup> (oil pressure)
Injection rate:	80%

- Methods of evaluating properties -

1) Colouring property

Mouldings (120 x 120 x 3 mm) with 0.5 mm thick film gate on one side, ribs with a thickness of 1.5 mm and height 10 mm over the entire length from the gate side to the opposite side, in the central part of the moulding, were prepared under the moulding conditions specified above and the blackness of the mouldings was evaluated visually.

2) Chemical resistance

Kerosene was applied on the moulding prepared as mentioned above and the moulding left standing for 24 h. It was then checked visually for whitening on the surface.

3) Rib strength

From the gate side of the test mouldings made as described above, 3 test specimens (10 mm wide) for measuring rib strength were cut out parallel to the gate side. One end of a specimen was fixed to a chuck of an Autograph tester and a piece that can hook to the base of the rib was attached to the other chuck. The breaking strength of the rib was measured at 23° C while pulling at 10 mm/min. The mean breaking strength of the three specimens was calculated.

4) Laminar detachment

Mouldings made as described above were detached from the film gate side and checked visually for laminar detachment.

5) Impact strength

1/4<sup>th</sup> inch thick specimens for Izod impact test were moulded under the same moulding conditions as listed above. The notched Izot impact strength of the specimens was tested at 23° C and -30° C (as per ASTM D-256).

6) Workability

Using pellets of each composition that had been blended in a Banbery mixer, the flow property was measured in a "Koka" type flow tester, at 210° C and 30 kg/cm<sup>2</sup>.

<Effectiveness of the invention>

It is clear from a comparison of the results obtained in the examples (Table 3 and 4) with those of the comparative examples (Table 5), the weather resistant resin composition consisting of constituents (I), (II), and (III) explained below has superior colouring property, chemical resistance and rib strength.

- (I) Ethylene- $\alpha$ -olefin rubber-based graft polymer, 40 wt.% or less of the true graft polymer portion of which is soluble in a solvent mixture of tetrahydrofuran and n-hexane, and 60 wt.% or less of it is insoluble in tetrahydrofuran
- (II) An alkyl acrylate rubber-based graft polymer
- (III) An unsaturated carboxylic acid alkyl ester-based polymer

Applicant: Sumitomo Naugatuck Co. Ltd.